Nano-Optics

The increasing trend towards nanoscience and nanotechnology makes it inevitable to study **optical phenomena on a nanometer scale**.

In the **nanowire single-photon source**, a quantum dot (QD) emits exactly one photon per trigger. The optical environment is tailored on a nanoscale to ensure that the photon emission is directed preferentially towards the collection optics for subsequent use in quantum information processing.

The long photon escape time and the strong local density of states in the **micropillar cavity** allows for coherent interaction between the QD and the optical mode, leading to cavity quantum electro-dynamical effects.

Scanning electron micrograph of a micropillar.

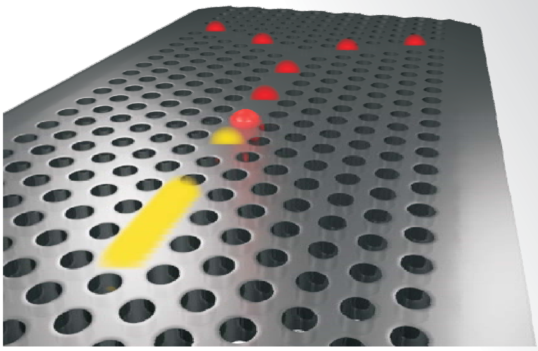
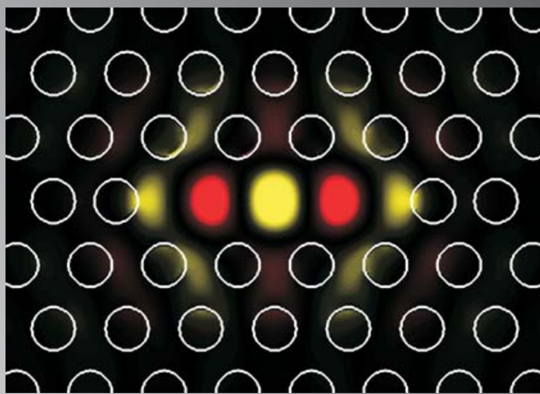


Illustration of the photonic crystal membrane.

Front cover of Nature Photonics showing the light emission profile for the nanowire.



Field profile of an optical mode in a photonic crystal cavity.

The photonic bandgap in the **photonic crystal membrane** prevents light propagation in the periodic lattice. Defects are introduced in order to localize and guide light. The strongly perturbed local density of states results in slow-light propagation and an enhanced interaction with matter, as required in high-speed all-optical signal processing.

These are but a few examples of the many promising applications of nano-optics.

Information

Course number: 34092
Course title: Nano-Optics
Points: 5 ECTS
Schedule: Fall (13 weeks)
Exam: Oral
Grade: Passed/failed

General course objectives:
To give the students an overview of the most interesting subjects within nano-optics.

Learning objectives:
A student who has met the objectives of the course will be able to:

- **Demonstrate** an overview of some of the most interesting research fields within nano-optics.
- **Relate** electromagnetic fields to the dyadic Green's function.
- **Design** and **analyze** photonic cavities.
- **Describe** different types of quantum emitters and their use in nano-optics.
- **Distinguish** between and **estimate** different types of decay rates in homogeneous and non-homogeneous environments.
- **Evaluate** and interpret the content of the materials/articles supplied.
- **Formulate** critical and/or enlightened questions to the speaker.
- **Communicate** methods, result and conclusions to other students.
- **Argue** scientifically in a discussion.

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